

In the Specification:

Please amend the paragraph at **page 1, lines 11 to 17**, as follows:

Conventionally, in relation to a wood golf club head, ~~especially,~~ especially a driver club head, various kinds of efforts have been made to improve the flight distance of a golf ~~ball.~~ ball struck by such a club head. Experience has ~~[[been]]~~ shown that a launch angle and a backspin speed of a golf ball after striking it as well as the head speed of ~~[[a]]~~ the golf club being used should be appropriately determined in order to increase the flight distance of ~~[[a]]~~ the ball.

Please amend the paragraph at **page 2, lines 7 to 11**, as follows:

However, there ~~[[has]]~~ have been no formulations to describe the correlation between the club head speed, ball launch angle and backspin rate, especially the correlation between the ball launch angle and backspin rate in order to improve the ball flight distance more effectively.

Please amend the paragraph at **page 5, lines 13 to 25**, as follows:

The present invention has been made in view of these circumstances. The wood golf club head ~~claimed in claim 1~~ according to a first embodiment of the present invention is designed so that the launch angle and backspin speed of a golf ball can be located in the region defined by the ellipse, shown in FIG. 2, whose center is positioned on ~~Point~~ point O(21, 1800), length of a major axis L is equal

to 2100(rpm), length of a minor axis S is equal to 5.7(deg), and gradient  $\theta$  of the major axis measured in a counterclockwise direction from the vertical axis is equal to 0.25(deg), wherein the horizontal coordinate designates the launch angle(deg) of a golf ball, the vertical coordinate designates the backspin speed(rpm) of a golf ball, and the horizontal and vertical axes are on the same ~~scale.~~ scale, i.e. have the same numerical scale and spacing.

Please amend the paragraph at **page 6, lines 1 to 11**, as follows:

Fig. 2 illustrates the correlation that the ball launch angle and backspin should satisfy irrespective of the ball ~~speed that~~ speed, which is one of the initial ~~parameter~~ parameters at the onset of ball launch. The region defined by this ellipse is determined to encompass the entire region of the maximum ball flight distance that is achieved at various ball speeds. That is, by designing a wood golf club head so that the ball launch angle and backspin can satisfy, at any ball speed, the correlation defined by the ellipse shown in FIG. 2, a wood golf club head that can describe the optimum trajectory of a golf ball is achieved.

Please amend the paragraph at **page 7, lines 3 to 16**, as follows:

The wood golf club head ~~claimed in claim 2~~ according to a second preferred embodiment of the invention is designed so that the launch angle and backspin speed of a

golf ball can be located<sup>"))</sup> in the region defined by the ellipse, shown in FIG. 3, whose center is positioned on ~~Point point~~ O(23, 1700), length of a major axis L is equal to 1900(rpm), length of a minor axis S is equal to 3.9(deg), and gradient  $\theta$  of a major axis measured in a counterclockwise direction from the vertical axis is equal to 0.19(deg), wherein the horizontal coordinate designates the launch angle(deg) of a golf ball, the vertical coordinate designates the backspin speed(rpm) of a golf ball, and the horizontal and vertical axes are on the same scale. scale, i.e. have the same numerical scale and spacing. Additionally, in FIG. 3 as well, the scale of the horizontal axis is considerably expanded relative to the scale of the vertical axis for the purpose of illustration.

Please amend the paragraph at **page 7, lines 17 to 25**, as follows:

The ellipse of FIG. 3 is included in the region defined by the ellipse shown in FIG. 2, but FIG. 3 shows the correlation that the ball launch angle and backspin speed should satisfy to achieve 99% of the maximum ball flight distance especially at the ball speed of 50m/s in the region ~~off FIG. 2.~~ of FIG. 2. The reason why the ball speed of 50m/s is particularly selected here is that the wood golf club head ~~claimed in claim 2~~ according to the second embodiment is designed for an average golfer whose club head speed is somewhat slower.

Please amend the paragraph at **page 8, lines 8 to 21**, as follows:

The wood golf club head ~~claimed in claim 3~~ according to a third embodiment of the invention is designed so that the launch angle and backspin speed of a golf ball can be located in the region defined by the ellipse, shown in FIG. 4, whose center is positioned on ~~Point~~ point O(23, 1700), length of a major axis L is equal to 1400(rpm), length of a minor axis S is equal to 2.8(deg), and gradient  $\theta$  of a major axis measured in a counterclockwise direction from the vertical axis is equal to 0.19(deg), wherein the horizontal coordinate designates the launch angle(deg) of a golf ball, the vertical coordinate designates the backspin speed(rpm) of a golf ball, and the horizontal and vertical axes are on the same ~~scale~~. scale, i.e. have the same numerical scale and spacing. Additionally, in FIG. 4 as well, the scale of the horizontal axis is considerably expanded relative to the scale of the vertical axis for the purpose of illustration.

Please amend the paragraph at **page 8, line 22, to page 9, line 4**, as follows:

The ellipse of FIG. 4 is also included in the region defined by the ellipse shown in FIG. 2, but FIG. 4 shows the correlation that the ball launch angle and backspin speed should satisfy to achieve 99.5% of the maximum ball flight distance especially at the ball speed of 50m/s in the region of FIG. 2. The wood golf club head ~~claimed in claim 3~~, according to the third embodiment, as with the

club head ~~claimed in claim 2,~~ according to the second embodiment, is designed for an average golfer whose club head speed is somewhat slower.

Please amend the paragraph at **page 9, line 12, to page 10, line 6,** as follows:

~~According~~ With respect to the wood golf club head ~~claimed in claim 4, in the invention claimed in claim 1, 2 or 3,~~ according to a fourth aspect in connection with the first, second or third embodiment of the invention, the above-mentioned ellipse is determined by solving the equation of motion via numerical analysis using the following equations:

$$F_x(t) = -1/2(C_D(t)\cos \alpha + C_L(t)\sin \alpha) \rho A V_B(t)^2;$$

$$F_y(t) = -1/2(C_D(t)\sin \alpha - C_L(t)\cos \alpha) \rho A V_B(t)^2 - mg;$$

and

$$N(t+\Delta t) = - \rho A d C_m(t) V_B(t)^2 \Delta t / (4\pi I) + N(t);$$

where  $F_x(t)$  is force applied to a ball in flight in the flight direction at time instant  $t$ ,  $F_y(t)$  is force applied to a ball in flight in the vertical direction at time instant  $t$ , and  $N(t+\Delta t)$  is decrease in the rotational speed of a ball due to aerodynamic torque after interval of  $\Delta t$ ; and where  $C_D$ : drag coefficient,  $C_L$ : lift coefficient,  $\alpha$ : elevation angle of a ball(deg),  $\rho$ : air density(kg/m<sup>3</sup>),  $A$ : sectional area of a ball (m<sup>2</sup>),  $V_B$ : ball velocity(m/sec),  $m$ : ball mass(kg),  $g$ : gravitational acceleration(m/sec<sup>2</sup>),  $C_m$ : moment coefficient,  $d$ : ball diameter(m),  $I$ : moment of inertia of a ball (kg·m<sup>2</sup>),  $N$ : ball rotational speed(rps).

Please amend the paragraph at **page 10, lines 7 to 10**, as follows:

~~According~~ With respect to the wood golf club head ~~claimed in claim 5, in the invention claimed in claim 1, 2 or 3,~~ according to a fifth aspect in connection with the first, second or third embodiment of the invention, a face, or striking surface, of the wood golf club head is formed of a low friction material.

Please amend the paragraph at **page 11, lines 7 to 16**, as follows:

Therefore, in order to put these dots inside and near the ellipse, it is necessary to enlarge only the launch angle without increasing the backspin speed. For that reason, some measures to increase the loft as well as to decrease the backspin speed are required. As an example, a low friction material may be utilized on the face of the golf club head so as to decrease the coefficient of friction of the face relative to the ball. Alternatively, a coating layer may be formed on the face. The invention ~~claimed in claim 5~~ according to a fifth aspect has been made in view of these standpoints.

Please amend the paragraph at **page 12, lines 1 to 12**, as follows:

Techniques to decrease the coefficient of friction of the face are, as described according to a sixth aspect of the invention, ~~in the invention claimed in claim 6,~~ any one of the coatings such as DLC(Diamond-like carbon) film coating, ceramic coating, and SiC coating. In these coating layers, especially, the DLC coating layer having

a coefficient of friction" of 0.1 or less, which is lower relative to the metal nitride film or the like, is more preferable. Also, the DLC coating layer has a higher hardness and thus, a superior wear resistance. The ceramic coating can achieve an ultra-low coefficient of friction by doping ~~Teflon®~~ TEFLON® (tetrafluoroethylene fluorocarbon polymer or fluorinated ethylene-propylene polymer; DuPont) into the minute pores of the ceramic film. The SiC coating has a higher hardness and thus, it is superior in wear resistance.

Please amend the paragraph at **page 12, lines 13 to 18**, as follows:

Also, as described ~~in the invention claimed in claim 7, Dyneema®~~ according to a seventh aspect of invention, DYNEEMA® FRP (DFRP: Ultra-High-Strength Polyethylene Fiber Reinforced Plastic; TOYOBO Co., Ltd.) may be used as a face material. In this case, the coefficient of friction of the face can be reduced and besides, the strength of the face can be improved.

Please amend the paragraph at **page 12, lines 19 to 22**, as follows:

Moreover, as described ~~in the invention claimed in claim 8,~~ according to an eighth aspect of the invention, chromium plating or dispersed nickel plating may be utilized on the face to decrease the coefficient of friction of the face.

Please amend the paragraph at **page 12, line 23, to page 13, line 2**, as follows:

Alternatively, as described ~~in the invention claimed in claim 9,~~ according to a ninth aspect of the invention, the face may have an insert formed of polyacetal (POM), polyamide (PA), polytetrafluoroethylene (PTFE), polyphenylenesulfide (PPS), polyamideimide (PAI), or polyimide (PI).

Please amend the paragraph at **page 13, lines 7 to 12**, as follows:

Also, as described ~~in the invention claimed in claim 10,~~ according to a tenth aspect of the invention, the face of a wood golf club head may be formed of composite materials that are made from pitch-based carbon fiber and a pitch-based matrix. Since such composite materials are superior in wear resistance, they are preferable as a face material.

Please amend the paragraph at **page 13, lines 13 to 15**, as follows:

According to an eleventh aspect in connection with the first, second or third embodiment, and/or the fourth aspect of the invention, ~~the invention claimed in claim 11, in any one of claims 1 to 4,~~ the wood golf club head may be a driver club head.



Please amend the paragraph at **page 13, lines 16 to 18**, as follows:

According to a twelfth aspect in connection with the first, second or third embodiment, and/or the fourth aspect of the invention, ~~the invention claimed in claim 12, in any one of claims 1 to 4,~~ the wood golf club head may be a driver club head whose loft (i.e. loft angle) is 13 to 20 degrees.

Please amend the paragraph at **page 13, line 19 to page 14, line 6**, as follows:

Incidentally, the loft angle for a men's driver club of the prior art is generally 8 to 12 degrees. However, such a loft angle cannot achieve an adequate ball launch angle. Therefore, in order to obtain the maximum golf ball carry as in the present invention, a driver with a loft angle of 13 to 20 degrees is preferable. The degree of loft angle less than 13 degrees has difficulty in achieving a ball launch angle ~~more than~~ of 13 degrees or more. As a result, it becomes difficult to impact a golf ball within the elliptic regions described according to the first, second and third embodiments of the invention. ~~in the claims 1, 2 and 3.~~ Also, the degree of loft angle more than 20 degrees decreases the restitution ratio, or the ratio of the initial ball velocity relative to the club head speed. Thereby, the ball speed becomes lower, and thus, the golf ball carry will not be improved.

Please amend the paragraph at **page 14, lines 7 to 10**, as follows:

According to the ~~inventions claimed in claims 11 and 12~~, eleventh and twelfth aspects of the invention, a driver club head, which ~~is required most~~ requires the greatest ball flight distance ~~in among~~ wood golf club heads, can describe the optimum trajectory of a golf ball.

Please amend the paragraph at **page 15, lines 16 to 18**, as follows:

A wood golf club head according to the present invention is shown in FIG. 1. Here, a driver club head is shown by way of example.

Please amend the paragraph at **page 15, line 24 to page 16, line 4**, as follows:

To be concrete, the face 2a is coated with DLC(Diamond-like ~~Coating~~). Carbon coating. DLC is a thin carbon film formed by a vapor phase synthetic method using hydrocarbon or solid carbon as a raw material. Since the DLC film has a lower coefficient of friction of 0.1 or less and a superior wear resistance, it is more preferable as the face material of a driver club head.

Please amend the paragraph at **page 16, lines 5 to 15**, as follows:

Also, the face 2a may be coated with ceramic or SiC. The ceramic coating can achieve an ultra-low coefficient of friction by doping ~~Teflon®~~ TEFLON® (tetrafluoroethylene

fluorocarbon polymer or fluorinated ethylene-propylene polymer; DuPont) into the minute pores of the ceramic film. The SiC coating has a higher hardness and a superior wear resistance. Moreover, the face 2a may be composed of ~~Dyneema®~~ DYNEEMA® FRP (DFRP: Ultra-High-Strength Polyethylene Fiber Reinforced Plastic). In this case, the coefficient of friction of the face 2a can be reduced and besides, strength of the face 2a can be improved. Furthermore, the face 2a may be plated with chromium or dispersed nickel to reduce the coefficient of friction thereof.

Please amend the paragraph at **page 21, lines 12 to 20**, as follows:

~~Because the~~ The degree of loft less than 13 degrees has difficulty in achieving a ball launch angle of 13 degrees or more immediately after ball impact. As a result, it becomes difficult to impact a golf ball within the above-mentioned elliptic regions. On the other hand, the degree of loft more than 20 degrees decreases the restitution ratio, or the ratio of initial ball velocity relative to club head speed, thereby decreasing the ball speed. As a result, the golf ball carry will not be improved.

Please amend the paragraph at **page 21, lines 21 to 24**, as follows:

According to the present invention, a driver club head, which requires ~~is required most~~ the greatest ball flight distance ~~[[in]]~~ among wood golf club heads, is achieved that can describe the optimum trajectory of a golf ball.

**[RESPONSE CONTINUES ON NEXT PAGE]**